AQA

AS
COMPUTER SCIENCE
7516/2

Paper 2

Mark scheme
June 2019

Version: 1.0 Final

I196A75I62/MS

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk

Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student's answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.

AS Computer Science

Paper 2 (7516/2)

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To Examiners:

- **When to award '0' (zero) or '–' (hyphen) when inputting marks on CMI+**

  A mark of 0 should be awarded where a candidate has attempted a question but failed to write anything creditworthy.

  Insert a hyphen when a candidate has not attempted a question, so that eventually the Principal Examiner will be able to distinguish between the two (not attempted / nothing creditworthy) in any statistics.

- This mark scheme contains the correct responses which we believe that candidates are most likely to give. Other valid responses are possible to some questions and should be credited. Examiners should refer responses that are not covered by the mark scheme, but which they deem creditworthy, to a **Team Leader**.

The following annotation is used in the mark scheme:

; - means a single mark
// - means an alternative response
/ - means an alternative word or sub-phrase
A - means acceptable creditworthy answer
R - means reject answer as not creditworthy
NE - means not enough
I - means ignore
DPT - means "Don't penalise twice". In some questions a specific error made by a candidate, if repeated, could result in the loss of more than one mark. The **DPT** label indicates that this mistake should only result in a candidate losing one mark, on the first occasion that the error is made. Provided that the answer remains understandable, subsequent marks should be awarded as if the error was not being repeated.

Examiners are required to assign each of the candidate's responses to the most appropriate level according to **its overall quality**, and then allocate a single mark within the level. When deciding upon a mark in a level examiners should bear in mind the relative weightings of the assessment objectives.

eg

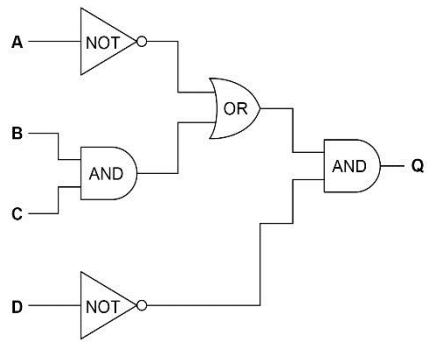
In the following question the marks available are as follows:

Question 11 (max 9 marks)
AO2 (analyse) – 9 marks

Where a candidate's answer only reflects one element of the AO, the maximum mark they can receive will be restricted accordingly.

Qu		Marks	
01	1	**Mark is for AO1 (understanding)** The set of integers includes negative (whole) numbers; The set of natural numbers do not contain negative (whole) numbers; **Max 1**	1
01	2	**Mark are for AO1 (understanding)** Rational numbers are any numbers able to be represented/expressed as fractions/one integer divided by another; Irrational numbers are any number that are not able to be represented/expressed as fractions/one integer divided by another; **Max 1**	1
02	1	**Mark are for AO2 (apply)** B7;	1
02	2	**Mark is for AO1 (understanding)** More compact when displayed; Easier (for people) to understand/remember**; A**. read Lower likelihood of an error when typing in data; Saves (the programmer) time writing/typing in data; **NE.** takes up less space **R**. if answer states that hexadecimal uses less memory/storage **Max 1**	1
02	3	**Marks are for AO2 (apply)** **1 mark** for whole number 19 **1 mark** for decimal number: .53125 // 17/32	2
02	4	**Marks are for AO2 (apply)** The (positive number) 00100111 must be converted to its negative equivalent/11011001; The (negative number) 11011001/result must then be added to the second number/01001001 (equalling 00100010); **Note:** Award 1 mark if both working **and** correct answer shown but no explanation	2

03	1	**Mark is for AO2 (analyse)** Subtract 48 / 00110000 from the character code / bit pattern; AND the character code / bit pattern with the bit pattern 00001111; XOR the character code / bit pattern with the bit pattern 00110000; **Max 1**	1
03	2	**Marks are for AO1 (understanding)** Introduced to support a larger range of characters; Due to increased international communication // use of files in multiple countries; **A.** sensible alternatives to international communication: eg facilitate interchange of documents between countries. eg culturally unacceptable to only allow non-English speaking countries to communicate in English **NE.** use in other countries or examples of this. Each character code is always interpreted as the same character; **Max 2**	2
04	1	**Marks are for AO2 (apply)** 768;	1
04	2	**Marks are for AO2 (apply)** Identification of length (200s / 3 * 60 + 20), sample resolution (16 bit) and sample rate (44,100 Hz) in working; **A**. 44.1 (kHz) for sample rate Showing the correct calculation ((3 * 60+20) * 16 * 44,100 // 200 * 16 * 44,100) or showing correct intermediary value (141,120,000 (bits) / 17,640,000 (Bytes)); **I**. Conversion. **A**. Allow follow through as long as it is clear the student is attempting to multiply length, sample rate and sample resolution. Conversion of answer in bits to megabytes (17.64MB); **I**. Incorrect value for number of bits. **A**. rounded up to fewer significant places as long as correct method can be seen in working. **Max 2** if final answer is incorrect **Award** 3 marks if final answer 17.64MB	3
05	1	**Mark is for AO1 (knowledge)** The electronic / electrical / physical / mechanical components of the computer system; **NE.** Tangible without further explanation.	1

05	2	**Mark is for AO1 (knowledge)** Instructions / code / programs;	1
05	3	**Marks are for AO1 (understanding)** System software is software that controls/manage the operation of (some aspects of) the computer system // software which enables user to operate a computer // system software is required to operate a computer; Application software is for carrying out tasks that are user-oriented / that the user would want to do even if they did not have a computer system;	2
05	4	**Marks are for AO1 (knowledge)** **1 mark** for Compiler checked **1 mark** for Operating system checked **R**. Award 0 marks if more than two lozenges shaded	2
06	1	**Mark is for AO1 (knowledge)** NOR;	1
06	2	**Marks are for AO2 (apply)** **Mark as follows** **1 mark** for B and C into AND gate **1 mark** for the result of B and C (**I.** incorrect gate) as one input and a NOT gated A as a second input to an OR gate **1 mark** D connected to NOT gate and output of this to an AND gate, the results of A, B and C (**I.** previously incorrect gates) as the other input, with the output going into Q **MAX 2** if not fully correct  	3
06	3	**Mark is for AO1 (understanding)** OR; **A**. A+B // +	1

06	4	**Marks are for AO2 (apply)** **Marking guidance for examiners** • Award marks for working out until an incorrect step has been made. • If, in any one step, a candidate is simplifying different parts of an expression simultaneously award all relevant marks for this multiple stage but don't award any further marks for working in any parts simplified incorrectly. Example, if the expression P.P.(P+Q) + P.P.1 was changed to P.(P+Q)+P.0, the candidate would get one mark for simplifying the first part to P.(P+Q) and could get further marks for correctly simplifying this part of the expression further but should not be awarded marks for simplifying the incorrectly changed part P.0 (ie to 0) **Mark as follows** **1 mark** for final answer A **3 marks for working** **Max 3** for working. Award up to two marks for applying each one of the three techniques (one mark per application): • a successful application of De Morgan's Law (and any associated cancellation of NOTs) that produces a simpler expression • applying an identity other than cancelling NOTs that produces a simpler expression • successfully expanding brackets **Note:** A simpler expression is one that is logically equivalent to the original expression but uses fewer logical operators. **Note:** Any application of De Morgan's Law or expanding brackets which result in an expression which should be bracketed must be shown with brackets to be awarded a mark. **Example working (1)** $A \cdot (A + C) \cdot \overline{A} \rightarrow A \cdot \overline{A}$ [Absorption] $A \cdot \overline{A} \rightarrow 0$ [Complement] $\overline{(\overline{A} \cdot \overline{A \cdot B})} \rightarrow A + A \cdot B$ [De Morgan's Law] $A + A \cdot B \rightarrow A$ [Absorption] $0 + A \rightarrow A$ [Identity] **Example working (2)** $A \cdot (A + C) \cdot \overline{A} \rightarrow A \cdot \overline{A}$ [Absorption] $A \cdot \overline{A} \rightarrow 0$ [Complement] $\overline{(\overline{A} \cdot \overline{A \cdot B})} \rightarrow \overline{(\overline{A} \cdot (\overline{A} + \overline{B}))}$ [De Morgan's Law] $\overline{(\overline{A} \cdot (\overline{A} + \overline{B}))} \rightarrow \overline{\overline{A} + \overline{A} \cdot \overline{B}}$ [Associative] $\overline{\overline{A} + \overline{A} \cdot \overline{B}} \rightarrow \overline{\overline{A}}$ [Absorption] $\overline{\overline{A}} \rightarrow A$ [Double Not] $0 + A \rightarrow A$ [Identity]	4

07		**Marks are for AO1 (understanding)** • The address of the memory to be written to is placed on the address bus (by the processor); • The data to be written is placed on the data bus (by the processor); • The signal to write is placed on the control bus (by the processor); • The control bus carries a clock signal (to synchronise the memory and processor); • When the write signal is received (by the memory) on the control bus; the data from the data bus is stored; into the location identified by the address bus; **A.** CPU for processor **NE.** Implication that the busses are doing the 'sending' rather than 'carrying' of data / addresses / signals **MAX 2** per bus **MAX 3** if only two buses referenced **MAX 4** marks	4
08	1	**Marks are for AO1 (understanding)** Magnetic disk drives are useful where large capacity is needed (without the cost of very large SSDs); Solid state disk drives have faster access speeds/lower latency than magnetic disk drives (which is useful for loading frequently used software) // access to data would be faster than if just magnetic disk drive was used; **R.** Faster by itself **Max** 1 if just differences are given rather than benefits of having both.	2
08	2	**Marks are for AO1 (understanding)** No movable parts (so no need for the read/write heads to move to the correct position); Purely electronic (so minimal latency);	2
09	1	**Mark are for AO1 (understanding)** A peer-to-peer network does not need a central server; A peer-to-peer network will be cheaper / easier to set up / maintain; The students are unlikely to need the extra security provided by a client-server network; The students are unlikely to need the extra services provided by a client-server network; **Max 2**	2
09	2	**Mark is for AO1 (knowledge)** A set of rules (which govern communication);	1
09	3	**Mark is for AO1 (knowledge)** The number of signal changes (which may occur) in a given period of time/in a second; **A.** rate **A.** voltage changes / number of symbols for signal changes as BOD	1

09	4	**Mark is are for AO1 (knowledge)** The range of frequencies that can be transmitted across a network connection;	1
09	5	**Marks are for AO1 (understanding)** WPA/WPA2 encrypted data (significantly) reduces the chance of unauthorised devices reading transmitted data; SSID Broadcast disabled makes it harder for people that don't know the SSID to join the network // SSID Broadcast disabled means the network (SSID) won't show up in a search; MAC address whitelisting means only approved devices can join the network;	3
09	6	**Marks are for AO1 (understanding)** **CSMA/CA and RTS/CTS** • Transmitting device checks for traffic; • If (data) signal present/another transmission is in progress, then the transmitter continues to wait; • If the channel is detected as idle, the transmitter would send a request to send (RTS); • Receiver/WAP (**A.** router **R.** server) responds (to RTS) with a Clear to Send (CTS) signal • If CTS is not received, the transmitter would wait a random amount of time/until the end of the transmission before resending the RTS; • When CTS is received, the transmitter begins transmitting data; • Receiver sends acknowledgement (ACK) (if all data is received); • If no ACK received then data is resent; **Max 6** for CSMA/CA and RTS/CTS **Majority Voting** • The transmitter would send each bit / byte / bit pattern (**R**. data) an odd number of times (greater than 2); **A.** multiple times / specified odd number greater than 2 • The receiver checks the bits / byte / bit pattern received and if they are not all the same it assumes the one it received the most copies of is the correct value; **R.** Receiver knows the data is correct **Max 2** for majority voting **Max 8** in total	8
09	7	**Marks are for AO1 (understanding)** Parity bits can only detect errors not correct them // Majority voting can correct (most) errors that occur during transmission; Majority voting can detect multiple (bit) errors; Majority voting is more efficient at detecting errors; Majority voting can (sometimes) detect an even number of errors; **Max 1**	1

10	1	**Marks are for AO2 (apply) and AO3 (program)**
		
		`MOV R0, #9`
		`MOV R1, #12`
		`MOV R2, #0`
		`startloop: AND R3, R0, #1`
		`CMP R3, #1`
		`BNE jump`
		`ADD R2, R2, R1 // ADD R2, R1, R2`
		`jump: LSR R0, R0, #1`
		`LSL R1, R1, #1`
		`CMP R0, #0`
		`BEQ endloop`
		`B startloop`
		`endloop:`
		
		Alternative Answer 1:
		`LSL R1, R1, #1` could be replaced with `ADD R1, R1, R1`
		
		Alternative Answer 2:
		`BNE jump` could be replaced with:
		`BEQ doadd`
		`B jump`
		`doadd:`
		
		AO2 (analyse) – 2 marks
		
		1 mark: Recognising that logical shift (`LSR`/`LSL`) is needed to perform integer division by 2 / multiplication by 2 even if the syntax used is incorrect.
		
		1 mark: Recognise that two comparisons and two branch instructions are needed even if the syntax is incorrect or the wrong types of branch instructions are used.
		
		AO3 (program) – 5 marks
		
		1 mark: `CMP R3, #1` before the `jump:` label and syntactically correct.
		
		1 mark: `BNE jump` before the `jump:` label and syntactically correct.
		
		1 mark: `ADD R2, R2, R1` is before the `jump:` label and syntactically correct.
		
		1 mark: `LSR R0, R0, #1` **and** `LSL R1, R1, #1` are after the `jump:` label and syntactically correct. **I.** order of commands
		
		1 mark: `CMP R0,#0` and `BEQ endloop` are after the `jump:` label, before `B startloop` and syntactically correct.
		
		Max 4 marks for programming if any syntax incorrect or program does not work correctly under all circumstances
		
		A. Answers that use hexadecimal or binary values
		DPT Missing hash for immediate addressing
		DPT incorrect use of commas, colons, semi-colons, line numbers, etc.
			7

<table>
<tr><td>10</td><td>2</td><td>Marks are for AO1 (understanding)

Machine code is binary/the actual instruction whereas assembly language is written using mnemonics;
Assembly language needs translating before it can run // machine code can be executed without needing to be translated;</td><td>2</td></tr>
<tr><td>10</td><td>3</td><td>Marks are for AO1 (understanding)

Both convert source code into object code;
An assembler takes assembly code / (simple) mnemonics as input while a compiler takes complex instructions / HLL code;</td><td>2</td></tr>
<tr><td>11</td><td></td><td>Marks are for AO2 (analyse)

Level of response question

<table>
<tr><th>Level</th><th>Description</th><th>Mark Range</th></tr>
<tr><td>3</td><td>A line of reasoning has been followed to produce a coherent, relevant and substantiated and logically structured response. The response covers at least four arguments, some of which have been expanded upon.

Answers must cover both ethical and legal arguments.</td><td>7–9</td></tr>
<tr><td>2</td><td>A line of reasoning has been followed to produce a mostly coherent, relevant, substantiated and logically structured response that covers at least four points (any mix of arguments and expansion points).

Answers must cover both ethical and legal arguments.</td><td>4–6</td></tr>
<tr><td>1</td><td>At least one argument has been made, possibly with an expansion point but there is no evidence that a line of reasoning has been followed.</td><td>1–3</td></tr>
</table></td><td>9</td></tr>
</table>

Examples could include:

Ethical

- Law enforcement officers may see disturbing images/messages on the phone which could affect the way they feel.
- This may be seen as a breach of privacy.
- Personal data such as photos of family may be lost.
- Law enforcement officers may misuse the phones for their own purposes.
- Law enforcement officers may be able to use the phone to contact (potential) victims and offer support.
- Law enforcement officers may use the phones to perform “stings” on other criminals.
- The ethical issue is one of creating "a slippery slope." If the law enforcement officers are granted access in this case, where will it stop? Will foreign governments have similar access – or the right for the encrypted data to be shared
- This could cause increased conflict between law enforcement officers and the public.
- People may have private photos/data which while legal may go against their culture or the cultural beliefs of the law enforcement officer.
- Breach of trust between manufacturer and client (count as legal if contract rather than trust).

Legal

- Relevant legislation identified with reference to personal information or privacy.
- Law enforcement officers may be able to make a decision not to press charges based upon evidence on the phone // May have to let people they believe to be guilty go free if they cannot access data.
- This may be in breach of (human rights of) privacy.
- Law enforcement officers may be able to use the data to solve other crimes.
- Law enforcement officers may be able to use the data to prevent further criminal activity.
- Allowing access to encrypted information stored on the phone may undermine the very freedoms and liberty that the law is meant to protect.
- Providing access to phones may also create a vulnerability that hackers (from hostile countries) can exploit.
- A legal issue when a judge gives permission for a phone’s encrypted data to be accessed and it can’t/it is refused.
- If we have the technology to prevent terrorist attacks by gaining valuable data from the attackers’ electronic devices then access to encrypted data should be allowed.
- The police may not keep the data as secure as the user wants.
- Law enforcement officers may edit the data on the phone.
- What level of authority/who is needed to give permission to a law enforcement officer to access data?
- Manufacturers may be breaking the law by refusing to allow access.

Students may be awarded marks for individual issues or expansions upon issues.

Expansion points may include further details on how the issue may arise or the impact of the issue occurring. Examples of expansion points could include:

- Law enforcement officers may accidentally lose data through inexperience.
- While it may be a breach in human rights privacy, this may be outweighed by lives saved.
- If personal data is lost, the owner of the phone may lose income from missed business appointments.